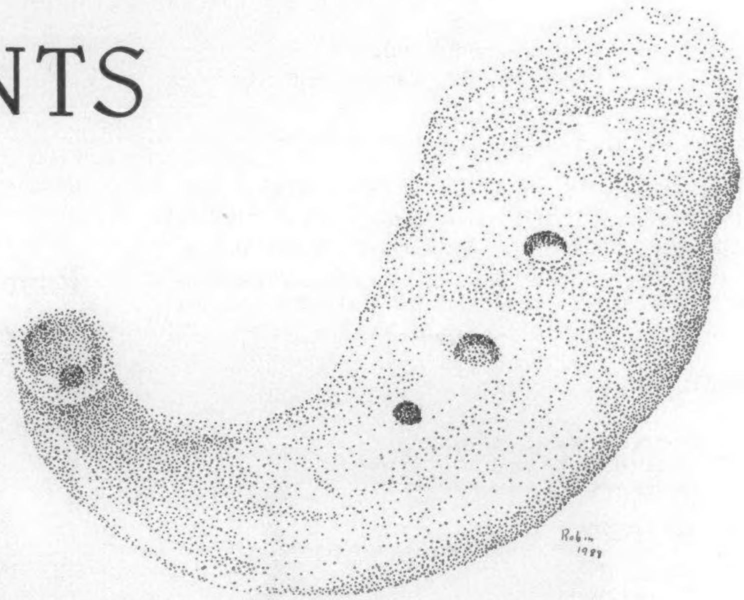
VOLUME IV NUMBER 2 PRICE 3.50 AUGUST 1988

FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF NEW SOUND SOURCES

EXPERIMENTAL MUSICAL INSTRUMENTS



THEIR SPIRIT LIVES IN THE MUSIC

In recent issues Experimental Musical Instruments has run articles on gourd and bamboo. These were the opening pieces in a series on natural materials for musical instrument making. The series continues with the article following here. This one brings together information on a variety of materials deriving from animals: bone, tusk, horn, seashell, and tortoise shell. (Some other animal derived materials, among them eggshell, gut and hide, will not be covered here, since we have plans for them in separate articles to come.)

We start with an overview of the materials and their use. Information on where to get what can be found at the end of that section. Following that is a more complete look at one particularly interesting instrument, a beautiful inverted recorder-like instrument made of polished cow horn by John Jordan. Along the way are descriptions, drawings and photographs of several beautiful instruments of shell, bone and horn by Bob Natalini, Bill and Mary Buchen, and builders from distant parts of the globe whose names have not come down to us.

IN THIS ISSUE

Above right: Sheep horn trumpet, drawn by Robin Goodfellow. From the artist's collection.

HORN, TUSK, BONE & SHELL

Introduction by Bart Hopkin, with thanks for assistance and information to Robin Goodfellow, Jonathan Glasier, Boone Trading Company, Michael Attaway and the Scrimshaw Gallery, and the New York Metropolitan Museum of Art.

Horn

Animal horns have been used in the creation of musical instruments since before the start of recorded history. Horns from the main species of domesticated livestock possess a natural form -- the elongated hollow cone -- ideal for creation of blown instruments. Horn is both strong and workable, and polished to a fine finish it can

(continued on page 4)

LETTERS

DEAREST EMI READERS

I would greatly appreciate any information you can offer on the subject of musical kites. I am in the process of collecting historical information as well as both ancient and contemporary designs of sound producing kites. If all goes well the end results will take the form of a travelling exhibition, as well as an audio-visual document. I look forward to hearing form you.

Until then...wishing good things!

Brian Lunger
2581 Vista Bay Rd.
Victoria, BC, Canada, V8P 3G1

THE EMI MAGAZINES, Vol. II arrived yesterday. I spent a wonderful afternoon listening to the Vol. II tape and reading the wide range of articles by such interesting people.

My interest in children is lifelong. I will soon be sixty-five and hope to match Minnie Black for creativity and longevity.

One thought pops up all the time -- the need for video tapes in providing teaching aids for people like me who have enthusiasm, but not a lot of musical background. I was really excited over the article regarding children with learning disabilities.

Boulder would be an ideal place for an EMI conference some time since we have a reputation for originality. We have the annual kinetic races which draw people from all over the area in May each year. Very exciting. It would be fun to have a whole week of music and madness some year in May.

Marilyn Houglan

From the editor: The material that follows is gleaned from several letters from intrepid explorer & correspondent Ivor Darreg.

Psycho-Ann-Alice's Yung Pink Freuds

The Sizzlephonic Group with the Multiple Personalities

Toozdi 8 Joon 1988

GREETINGS ---

Last Saturday evening, instrument builder Jim French played some of his wind instruments at the Sonic Art Gallery downtown. The ancient Greek Aulos, whistles and flutes, and horns made of real horn -- mellower tone than those of brass.

Important aspect was the upbeat mood of the audience.

You wrote me about the temperament demos I had sent a while back, so here is a new one -- there are 9 acoustic guitars hanging on my living room wall, and a tenth guitar is used on this cassette since there had to be an orthodox 12-tone guitar to compare with the others. [A cassette tape demonstrating guitars refretted to the several equal temperaments was enclosed with this letter.]

So ten guitars in ten scales: viz.: 12 14 15 16 17 18 19 22 24 31. (13 is taken care of by special aluminum bars which currently are at the Sonic Arts Gallery. 10 by heavy steel bars sawed out of old bedsprings. Just intonation is taken care of by the Megalyra family of instruments since the Newel Posts are tuned always to just chords, and the Megalyra are tuned to simple octaves and fifths, and bear just intonation fret lines.)

My 15-tone tubulong set is complete and mounted -- 3 octaves and a major 3rd. Laid out in three rows, each of which is a 5-tone course. [Tubulongs are steel conduit tubing marimbas.] This means four railings so that the second set straddles the railings of the first and third

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sets. The notes from 440 to 2000 Hz are 3/4" electric conduit pipe, and the upper notes are heavy-walled water pipe. To get some sustain at 4500 Hz. this is necessary.

Not very much has been done with 15-tone equal temperament, but I refretted a guitar to it about 8 years ago, and some of my visitors play it. Augusto Novaro in Mexico City in the 1920s tried out the scale. The idea is that 15 has 3 notes in common with orthodox 12-tone, so if the two scales are used together, there are three places to transfer back and forth from 12 to 15 to 12. I take these as F, A and C# to have the A-440 standard in common. I never went for Partch's idea of total incompatibility just to be ornery!

The advantage of metal tubing and bars of course is that tuning is rather permanent. These sets of tubes in various scales may very well last a century or more. A piano tuning begins to fade the moment the tuner turns his back. So piano tuning is the Labor of Sisyphus. How different to tune a set of bars or tubes that are about as stable as tuning forks.

Now, while it is easy enough to set out a fretting table for converting a guitar to this or that scale, just or tempered, and now with pocket calculators or computers the math is made very painless, there is still a problem how to measure tubing or bars using the now available data for various scales.

I get phone calls now and then about this. Very hard to explain over the phone when you can't see the other party or their instruments or know how much figuring they can do! This might help:

Rule of thumb. Approximately true. If a string is enough longer to be one octave lower than another string, i.e., if it is twice as long, or a fret is twice as far from the bridge, or a fretting table says twice the length makes the pitch one octave lower, then a xylophone or marimba or vibes bar or a conduit or aluminum tube or pipe will be **two** octaves lower, **not one**, for twice the length of the first bar or tube or pipe. While not perfectly exact, it is close enough to use for deciding where to make that hacksaw cut.

This means in turn that if you have a fretting table for a guitar or the like, giving the relative string-lengths, this will serve for the temperament having only half as many tones per octave -- that is, I wanted to rough-cut tubing for 15 tones per octave and I had tables for 30 tones per octave in string lengths.

Some pocket calculators will give you powers and roots. In this case, the 15th root of 2 would be used for laying out frets on a guitar to be in 15-tone, or for constructing a frequency table for the 15-tone equal temperament. But the 29th, 30th or 31st root of two would be used for getting approximate lengths for cutting wood or metal to make bar or tube instruments. Similarly, a quartertone (24-tone) fretting table would serve to get approximate bar or tube lengths for a regular 12-tone equal tempered marimba or tubulongs or vibes. The 23- or 25-tone tables would give approximate allowances for how much to cut of the next tube or bar, depending on whether you are going up or down in pitch from the first bar. Again, this is a rule of thumb and you will allow some more for the fine-tuning cutting since you can't put it back on!

Another reason for having a rule of thumb is to estimate how much material will be needed to build the instrument.

The above rule of thumb about the note **two** octaves lower being twice the length will not work for plucked metal reeds or tubular chimes or certain other kinds of instruments which obey different laws. Also be warned ahead of time that tube instruments eat up floor and storage space and it might be a good idea to keep them outdoors in the back yard. I have seem some studios where there was no place to sit down, and I don't want that to happen to you. Plan the instrument to be weatherproof or make a box to keep it in. Most of my bars and tubes are too loud for a livingroom anyhow. But fine outdoors.

Exciting Advantage: No burglar is going to steal something that will make that much noise being stolen and serve as its own burglar alarm.

I guess I wrote quite some time ago about the 10-tone scale not keeping the laid-back mood of equal 5-tone, but the 15-tone scale **does** conserve that mood and that is the main reason I decided to build it. Results like that prove the Theorists cannot predict the mood of a scale even when they do all kinds of calculations or even publish long-winded polemic arguments against scales they never have heard, or cannot build or tune an instrument to, or even in many cases do not want anyone else whomsoever to try out these scales or ever be permitted to hear them! I speak from over 60 years of bitter experience. I just turned 71 a few days ago and decades went by that I was denied access to this and access to that and given all kinds of nasty cruel mean withering arguments.

Why, oh why, do people on Power Trips usually use their power negatively -- to **stop** everybody else instead of to **start** other people on an adventure?

Funny deal on the radio newscast this morning -- somebody in your Marin County left a will asking that a party take place featuring the dropping of a piano from a helicopter! How's that for fulfilling my predictions about the Decline and Fall of the Pianofortic Empire?

Ivor Darreg

CORRECTION

In Skip La Plante's article "Music for Homemade Instruments," a sentence describing the suspended metal strip metimba appeared which read "Finally, the strip can be friction excited, with a superball ... or by blowing the edges of the strip." By now someone with strong lungs, taking their cue from that line, may have mastered the technique of sounding sheet metal by blowing ... but the word that should have appeared was "bowing," not "blowing." Apologies to Skip La Plante.

(More recent correspondence on page 18)

Horn, continued from page 1

be very beautiful.

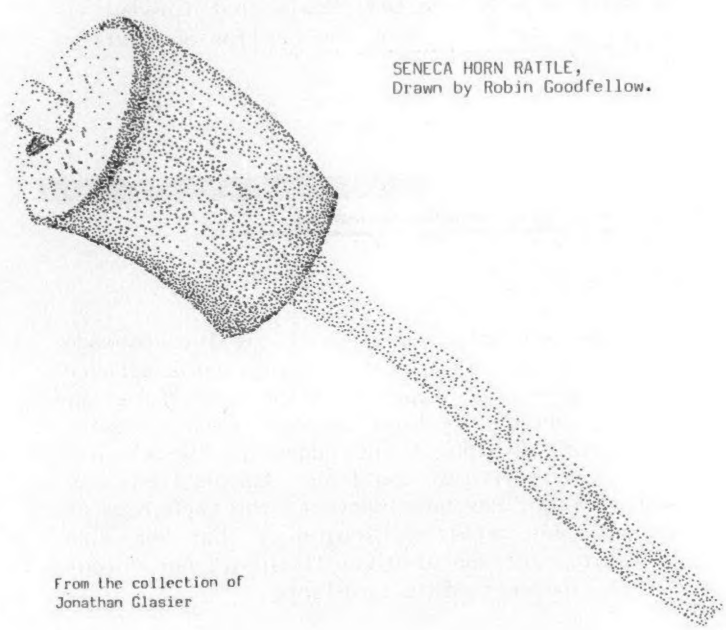
Horn can be worked using tools designed for plastic or woodwork. It can be sawed, carved, and filed. It can also be molded, within limits, after heating in a 350 degree oven. The surface can be left rough or scraped. Scraped horn has a fine matte finish which can be left as is or polished to a high luster. One caution: when heated, horn produces an unpleasant odor.

The least expensive and most easily obtained horn is cowhorn, in the form of longhorn or steer horn. Steerhorns are about one foot long, and can be had, ready sanded, for about $5 each. Longhorns reach about 20 inches long and can be had for about $9 sanded or $6 unsanded. Both of these types have some curvature and a nice, uniformly conical taper.

Cow horns have formed the basis of far more different wind instrument types than we could mention here, from Abeng (Ghanaian and Jamaican trumpets) to Zaqq (a Maltese bagpipe with horn chanter). Many instruments, usually identified as hornpipes, use a cylindrical tube of one material or another, coupled with a bell of cow horn, creating something akin to the flare typical of most brass instruments. Not all horn instruments are lip-buzzed; references to the 18th century Scottish Stock-and-Horn (not to be confused with the stockhorn) make it clear that it was a reedpipe. Likewise, John Jordan's instrument (discussed in the following article) is a fipple flute.

Cowhorn has also been used in non-wind insturment types, as some of the drawings and photos shown here illustrate.

Sheep and goat horn have been the source of many beautiful instruments. They typically range in length up to around 18 inches, and big sheep horns can be considerably longer. There are



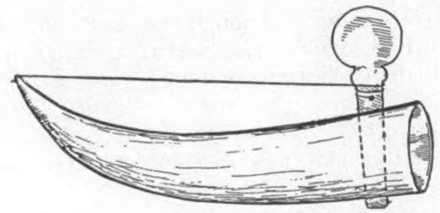
SENECA HORN RATTLE,
Drawn by Robin Goodfellow.

From the collection of
Jonathan Glasier

varying degrees of curvature. An 18 inch sheep horn can be had for about $20; longer horns cost more.

The best-known of sheep horn instruments is the shofar, described in the old testament and still in use today. The Talmud gives instructions for its construction and use. Many other instruments traditionally made of sheep or goat horn exist as well; some, such as the Latvian goat horn instrument called Azrags, include fingerholes.

Antelope horn has also been used in a number of blown instruments, such as the Nigerian Durum and Oduk. It is used in other instrument types as well; according to tradition, for instance, the first lyres had arms of antelope horn, and instruments with arms of antelope or gazelle horn have appeared in parts of Africa up to the present century.



SIMPLE ONE-STRING
DRONE FIDDLE*

TUSK

Animal tusks can have musical potential beyond the surfacing of piano keys. Their natural shape makes them suitable for many types of trumpets, reed instruments and whistles. Like horn, the quality of their substance is strong, workable and beautiful.

Most tusked animals are either endangered or protected species, and their are important questions of both law and conscience, not to mention expense, in the use of tusk. For these reasons animal horn will usually be the better choice of material in cases where tusk might have been used. The range of species producing usable tusk is greater than one might think, however, and one can at least consider options before dismissing the possibility.

Ivory is the much-prized material that is the substance of animal tusks. The nature of ivory -- its color, grain, hardness, inclination to split and the like -- varies depending on the species from which it comes. So does the size and shape of the tusk. With one or two exceptions, tusks used in the creation of ivory artifacts do not have the extraordinarily tough enamel that coats human and most animal teeth. Where enamel does exist, it normally must be removed by grinding before the ivory beneath can be worked.

Working ivory is much like working a very dense, hard wood, with one caution: it is heat sensitive, and will crack if allowed to overheat.

*This and other fanciful cowhorn-string designs seen in this article are from the pen of an anonymous doodler. They have never been built and come with no guarantee.

To reduce this problem, tools used on ivory should always be good and sharp. Coolants or lubricants used during cutting, such as WD40, may help too. Jewellers saws, hack saws and metal cutting blades on circular saws work well.

Several animal species produce usable ivory. Some of them are not well-known, and perhaps a little surprising. We'll start with the most familiar.

Elephant Ivory

Elephant tusks can range from a foot or so in length to over eight feet, and may weigh as much as 100 pounds in their natural state. Many have a hollow over a portion of their length (which houses a nerve in the live elephant), giving rise to a natural temptation to complete the hollow to create a bugle.

Elephant ivory trumpets have existed wherever the presence of elephants or commercial trade allowed for them. The Apwanga of the Kango people of Zaire and the Akua Oduk of the Ibibio people of Nigeria are both side blown ivory trumpets in use up to recent times. The most prominent ivory instrument in Europe was the Oliphant, which reached its peak of popularity in the 11th century. Oliphants were end blown ivory horns without finger holes, magnificently carved by Muslim craftsmen in Southern Italy, and highly valued by the European aristocracy (more for their beauty and connotations of wealth than as instruments).

Trade in elephant ivory is now restricted. There is no legal trade in Asian elephant ivory throughout most of the world. There is some African elephant ivory legally available, coming from countries where herds are stable. In Zimbabwe, for instance, herds are thinned every three years or so, producing some legally salable ivory.

Mastadon Ivory

Mastadons, you may have heard, have had to be removed from the endangered species list altogether. Mastadon ivory, however, is one of the most readily available forms. The tusks, as well as bones, have been preserved in the Alaskan and Siberian ice for tens of thousands of years, becoming partially mineralized in the process. The ivory is recovered by Eskimos, who are free to trade in it without legal restriction. Such tusks must be dried for three years or so before they are used.

Mastadon ivory resembles elephant ivory with some exceptions resulting from its age. It takes on remarkable colors as a result of the mineralization process. Whole tusks in good condition are not as common as imperfect specimens or fragments.

Warthog Ivory

Unlike most other pig's tusks, warthog tusks have no enamel. They are also considerably larger, reaching a foot in length and 1½" diameter at the base, and they are not prone to splitting. Like elephant tusks, they are partially hollow. The taper is not as smooth as with elephant tusks (they tend to end abruptly) and the ends are often worn. Warthogs are a protected species but there are no restrictions on the sale of the tusks.

Walrus Ivory, Hippopotamus Ivory, Whale Tooth & Narwhal Tusks

Walrus tusks can be long and beautiful, but for good reason they are rarely available legally. Mineralized walrus ivory, ranging from a few hundred to a few thousand years old, is only slightly less rare and quite expensive.

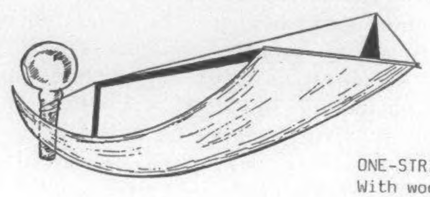
Hippopotamus tusks typically range up to about 16"; rarely to two feet or more. They are prone to cracking. They are not uniformly conical, appearing in various less-musical shapes. They have an enamel is which hard enough to destroy most cutting blades and must be ground off.

Whale teeth, usually less than eight inches long, are heavily restricted now and generally not available. The Maori Nguru is and endblown flute sometimes made of whale's tooth.

The rare and beautiful Narwhal, sometimes described as a marine unicorn, has a single straight tusk ranging in length up to about eight feet. Not surprisingly, the cost is prohibitive.

Costs for Tusks

For the larger animals, whether fossil or fresh, a small tusk of a foot or eighteen inches long begins to approach $100 in price; longer tusks may cost several hundred dollars and more. Note that tusks with a large hollow, which are good for creating trumpets, cost less than those with more ivory and less hollow. Warthog tusks, which are considerably smaller, are in the range of $15-$30 per tusk, depending on the size. Smaller hippopotamus tusks, up to a foot long or so, are in the same price range or just a little higher.



ONE-STRING FIDDLE
With wood soundboard
& suspended fingerboard

BONE

Several of the bones that make up animal skeletons have an approximately cylindrical shape, hollow when the marrow is gone, suggesting the creation of some sort of flute or whistle. Many cultures have used bone flutes, often with a sense that the music of the instrument will partake of the spirit of the animal. The Hottentot Arengas is an endblown flute made from the shinbone of a springbok. The Maori Kooauau was a flute with three fingerholes, diagonally blown, made of wood or bone, sometimes human thigh bone. The Navaho Atsazool is a whistle made from the humerus of a jackrabbit killed by an eagle. The Xhosa and Zulu make a flute called Impempe that can be made of bone, cane or (another intriguing animal material) porcupine quill.

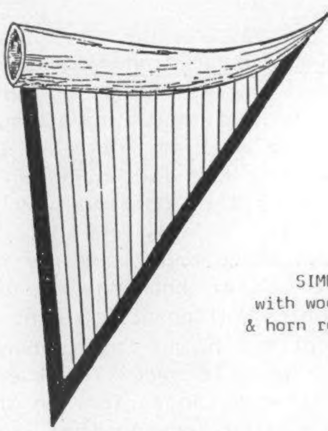
Bone can also be used idiophonically. The traditional Afro-American instrument simply called "bones," an important ingredient in the minstrel show tradition, has ancient antecedents in the Far East and Africa. The bones traditionally are rib

bones, slightly curved, played somewhat like castanets with two in each hand. More recently "bones" made of wood have become more common. Another traditional bone idiophone is the jawbone, called Quijada or Carraca in Latin America and Kauaha in Easter Island. The loose teeth in a dried jaw of a horse or donkey produce a distinctive sharp rattle when shaken or struck against another object.

Another bone percussion instrument is the prehistoric mammoth bone marimba described and recorded by archaeologist Sergei N. Bibikov in an LP reviewed in a recent issue of **Ethnomusicology**. Whether our early ancestors actually used this collection of bones as a musical instrument is a matter of speculation on Mr. Bibikov's part, but we do know that a group of present day archeologists had a good time jamming on it.

Some early central African lyres, in addition to using animal horns to support the yoke, are built over resonators made from skulls. A truly remarkable instrument from the collection of the Metropolitan Museum of Art appears in an MMA photo printed in David Reck's **Music of the Whole Earth**. It is a gazelle-horn lyre, with strings crossing an animal skin soundboard stretched over the open top of what is identified as a human skull, complete with long hair hanging down. More common in these early lyres were monkey skulls.

The most reasonable bones for flutes and percussion in our world now are the long leg bones of the large grazing animals that we raise to feed ourselves, as well as deer and other game that have died naturally or been killed by hunters. There is a certain value to honoring animals that we kill to sustain ourselves (as many cultures do in one way or another) by keeping a part of them alive in music.



SIMPLE HARP
with wood frame
& horn resonator

SHELLS & SHELL, BUT NOT SHELL

Here we mention two sorts of animal shell. Information on the musical uses of a third sort of shell, eggshell, which we had originally thought to include here, outgrew its allotted space and will appear separately in a later issue.

Seashells

Conch shell trumpets have been used by humans since neolithic times. They are dispersed through indigenous cultures over a wide geographic range, from pre-conquest South America through Oceania and southern Asia, and they are traditional in Europe as well. The widening spiral form makes for a natural conical bore, once the maker has carved out a mouthpiece for side- or end-blowing. Other seashell instruments include all manner of shell rattles, Hawaiian shells used like castanets, and the Spanish conchas de peregrino, which is comprised of two rough shells rubbed together.

Animal shell

Tortoise shells instruments have an honorable history in myth and legend. An oft-repeated story recounts how the first lute came into being when the entrails of a decaying tortoise happened to dry stretched across the shell; it was found that they produced a lovely sound when plucked. In Greek mythology Hermes is said to have created the first lyre by stretching animal skin over a dried tortoise shell to create the soundbox. He added antelope horns for the arms, and, along with the gut strings, created an entirely zoomorphic instrument -- an association the lyre has had ever since.

From the collection of Robin Goodfellow.

GUNBRI -- Turtle shell lutes of northern Africa. One of the instruments shown has the skin soundtable removed, showing the interior construction.

And it is in the lyre that tortoise shell has been put to its greatest use. While we don't know that European lutes or their immediate forebears ever were actually made of tortoise shell, many ancient lyres were. With the passage of time the makers of lyres have turned to other materials for the soundbox, ranging from wood to kerosene cans, but up until recently some traditional African lyres, such as the Odi played by some Ugandan peoples, still did use use a tortoise shell soundbox.

The north African gunbri or guinbri is a three-stringed (usually) plucked lute with turtle shell resonator, found in Morroco, Senegal and Gambia. On the other side of the world, the small, guitar-like Charango found in the Andes traditionally uses an armadillo shell soundbox.

The Seneca have a traditional turtle shell maraca-like rattle, similar in form to the Seneca horn rattle shown on page 4.

WHERE TO GET WHAT

The materials described here may be hard to track down. In fact, for many of them it is difficult even to decide what heading to look under in the phone book. In my local directory there is no listing for armadillo shell brokers.

For some of the items my research has not turned up any regular commercial suppliers. There may simply not be predictable channels through which they are available. Finding them becomes a matter of hit and miss. Other items have regular commercial channels but are in very irregular supply; their availability cannot be depended upon. One of the most promising suppliers of exotic materials I found in researching this article seems to have gone out of business and disappeared in just the few months since I located it. But other suppliers remain. Those mentioned here were especially helpful in providing of the information that went into this article.

In General:

Lapidaries, which specialize in mineral substances, sometimes also carry or are knowledgeable about bone, mineralized organic matter, & ivory.

Meat cutters: While large slaughtering houses may not be able to accommodate an individual builder's requests (they have their established procedures for cost-effective use of animal by-products), there are smaller "custom" operations, listed in the phone book under "meat cutting", which cater to small orders, preparing one or two or a few animals for the family table. They may be in a better position to meet the specific needs of an individual craftsman, particularly as regards horn or bone.

Taxidermists may also in some cases be able to come up with materials or leads on where to find things.

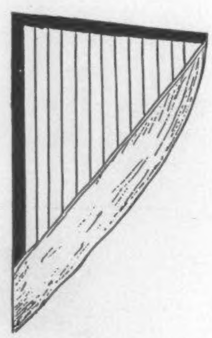
More Specifically:

Tandy Leather Co. (116 W. 25th Ave., San Mateo, CA 94403) carries long horn and steer horn. Catalog available.

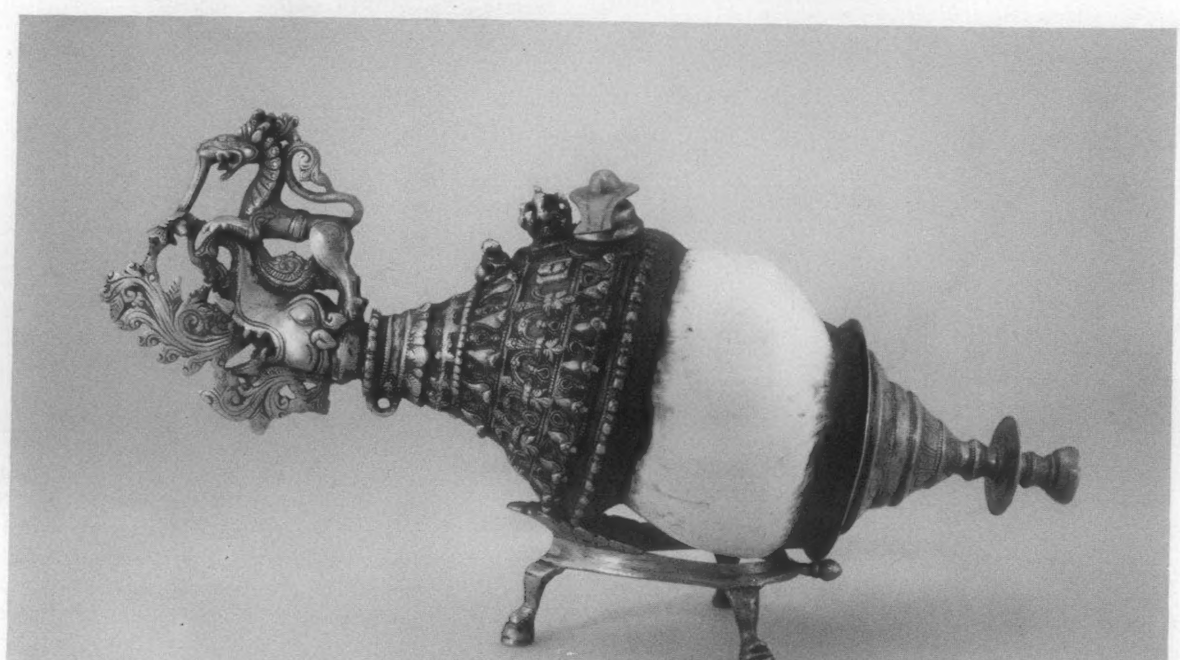
Boone Trading Company (562 Coyote Rd., Brinnon, WA, 98320) stocks all kinds of hard-to-find things. Stocks fluctuate according to availability of certain items, but they generally have (among many other things) sheep horn of various sorts and sizes, various other antlers & horns, ostrich eggs, fresh & mineralized tusks from several of the species mentioned above, and bone from exotic or extinct animals. Catalog available.

Scrimshaw Gallery, Pier 39, San Francisco, CA, 94133, deals in fresh and fossil ivory.

Conch shells, which are common and there for the taking on tropical beaches, turn up frequently on people's knick-knack shelves, but I failed to come across a reguler commercial source for them. I likewise failed to find a source for tortoise shells, but I still suspect that such sources do exist, since tortoise shell has more commercial applications than conch. At one point I was told I could obtain a whole tortoise shell from someone who runs a restaurant in Jamaica which sells turtle soup -- but that, unfortunately, did not pan out.



SIMPLE HARP with wood frame & soundboard glued over longitudinally-cut horn.



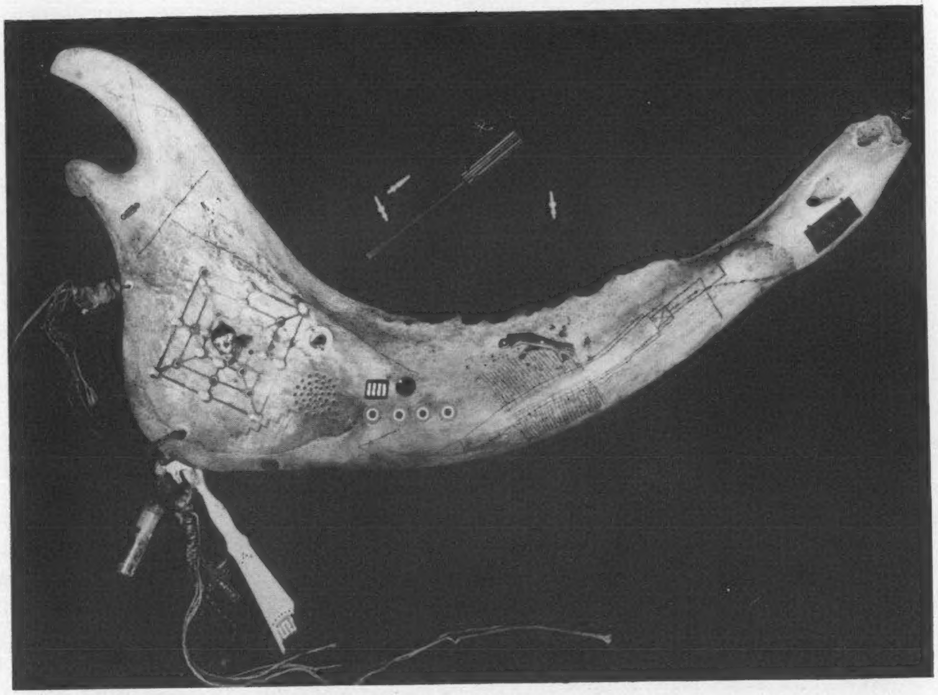
SANKH (CONCH-SHELL TRUMPET) with brass ornamentation, from India, 19th century.

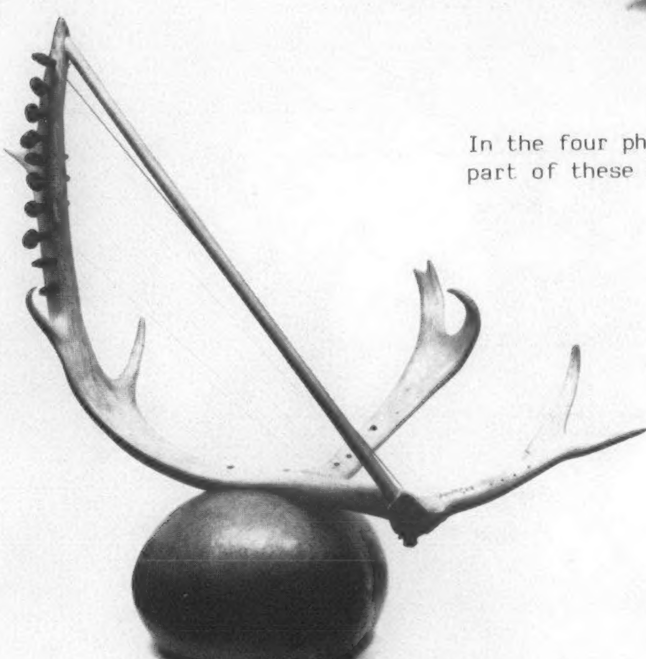
Photo courtesty of Metropolitan Museum of Art Purchase, The Barrington Foundation, Inc., Gift, 1986. 1986.12.

BOB NATALINI: ELECTRONICS & BONE

Starting with a cow jawbone, Bob Natalini has created the UNTITLED electronic bone music object shown at right in top and bottom views. From the artist's notes: "Among its many elements are: Electronics that produce two simultaneously harmonizing melodies; three tiny lit symbols that dance and change in time with the music; a tiny photo of the artist that bobs in and out of a window in the bone's surface; a sensor by which a viewer can manipulate the music; a secret switch for turning the lit symbols "on" (two of the elements on the bone's surface must be touched simultaneously); a small viewer that, when held up to the light and

(continued at far right)

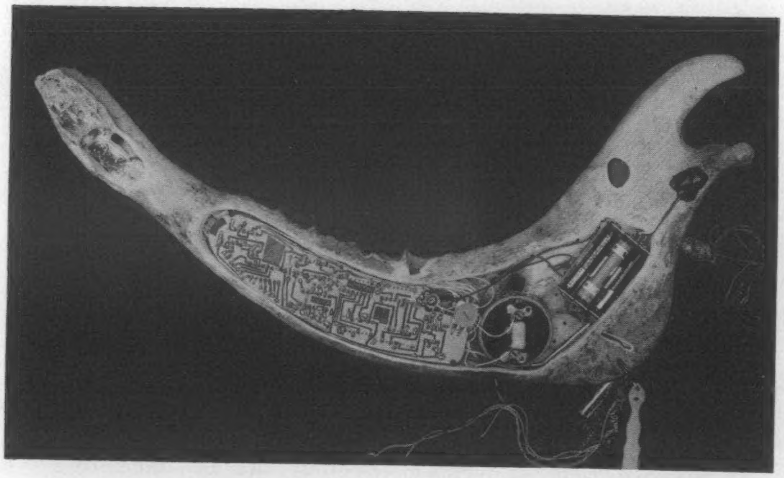




In the four photos in the lower part of these two pages --

THE BONEWORKS ENSEMBLE

They have since moved onto other things in the realm of sound exploration, but between 1976 and 1981 Bill and Mary Buchen worked extensively with instruments of bone. The Boneworks series of that period gave rise to instruments using elkhorn, cowhorn, turtle shell, gourd and wood, as well as bone in various forms. The Boneworks Ensemble, comprised of up to seven members, played works composed by Bill and Mary for the instruments, in diverse venues in New York and elsehwere. Some of the instruments are still traveling the country with an exhibit called **Other Gods**.



(continued from left)

looked into, reveals mystical religious motifs; controls for changing the speed, volume and pitch of the music; a system by which it turns all of its functions "on" and "off" automatically at adjustable intervals; and a "Nine Man's Morris" game board with tiny carved ivory men and women as its playing pieces."

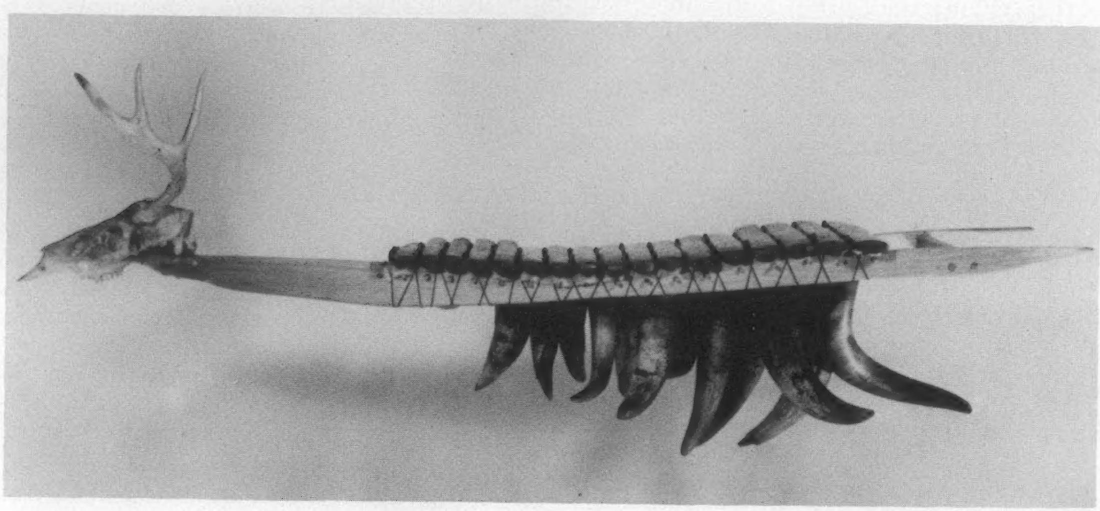
Bob Natalini is a jeweller and sculptor from Reading, Pennsylvania, whose assemblages have appeared in a great many exhibits and articles since 1966.

Middle left: The FLYING BEAVER TURTLESHELL RATTLES are made from beaver skulls, turtleshells, linen and pheasant feathers.

Middle right: The resonating chamber for the SKULLIMBA was given to the Buchens by a neighbor in their Lower East Side apartment, who in turn had found it there when she moved in. The soundboard is ebony.

Below left: The TREBLE ELK HARP shown here is one of a Boneworks elk horn family which includes tenor and bass instruments as well. The resonator is gourd; the pegs ebony, and those are steel strings. The Buchens' tuning is Phrygian.

At right: the ROSE-HORN MARIMBA. Resonators of cowhorn reinforce the sound of the rosewood slabs in the lower registers. A deer-skull embellishes the treble end. The tuning is diatonic.



A COWHORN FIPPLE FLUTE

By John Jordan

John Jordan is a maker and repairer of both early and contemporary instruments, emphasizing plucked and bowed strings but including also reproductions of baroque and renaissance woodwinds. Most of his instruments are built on commission, waiting time approximately 6-9 months. Write him at Jordan Music Services, 1236 Lindell Dr., Walnut Creek, CA 94596; phone (415) 938-5554 (after October 15 1988 write 1173 Linden Dr., Concord CA 94520 (415) 671-9246).

The instrument pictured here has no official name. I call it a Fipplehorn or sometimes an Ocowrina, but just for fun. It represents my most successful experiment into a question which has puzzled me for years: how to make a louder fipple flute.

I make quite a variety of woodwinds (mostly reproductions of renaissance and baroque instruments), and one thing that always intrigued me was how quiet the average fipple flute (tin whistle, recorder) was compared to the average reed instrument. The shawms and baroque oboes I make can drown out a whole consort of recorders, and while being able to drown something out is not musically important to me, I still felt it should be possible to makes something louder. It may occur to you that organ pipes or steam whistles are also fipple flutes and they are loud, but they are powered by air at much higher pressure than human lungs can produce and sustain. Since my goal was a lung powered instrument, I stayed closer to things I had already made.

Reed instruments also have an advantage over fipple flutes in the matter of compass: their pitch range can reach four octaves (even higher in some instances), while a fipple flute rarely has a range of more the $2\frac{1}{2}$ octaves. The question arose, would it be possible to create a fipple flute of larger range as well as greater volume?

The most obvious difference between a fipple flute and a reed instrument (other than the reed versus the fipple) is that, as a general rule, fipple flute bores are either cylindrical (like a tin whistle) or narrowing taper (like a baroque or modern recorder), while reed instrument bores are either cylindrical (like a clarinet not including the bell) or expanding taper (like an oboe or saxophone). Therefore, logically, a fipple flute could be made louder and with a larger pitch range than usual if the bore were larger than usual and cylindrical or, better yet, expanding taper.

The pictured instrument is 9" long, 2 1/8" x 1 3/4" (not quite circular) at the bell, and has five fingerholes on the front (no thumb hole in the rear). It has a range of four octaves starting at G# below middle C, but some notes are difficult to control.

The tests I've done using my Tracor 305 Sound Level Meter show that the fipplehorn is thirty-six decibels louder that a soprano recorder. (I tested three soprano recorders: a Cambridge plastic, a Moeck, and one I made. While the tone was different on each, the sound level varied only three decibels from quietest (the plastic) to loudest (mine)). All instruments were tested with all fingerholes closed, bell fully open and in fundamental mode (not overblown). I haven't had the opportunity to test the distance at which each instrument is audible, but thirty-six decibels is a big difference. If you are curious how much change in volume thirty-six decibels is, turn the volume knob on your stereo from 1 to 4, or, for those who listen louder, from 4 to 10 (assuming of course that your volume control is marked from 1 to 10).

With these improvements in pitch range and volume come certain disadvantages, of course. One of the primary reasons why fipple flutes in general are made with small cylindrical or narrowing taper bores is that large cylindrical and expanding taper bores take a lot of wind to play. Also, precise pitch control is much more difficult to achieve. On this instrument, I can achieve almost a semitone of pitch bending with breath alone, let alone covering the bell. Consequently, I do not think of this as a consort instrument but rather strictly as a solo instrument.

As for fingerings, the horn is intended to be played with the four fingers of the left hand covering the upper four fingerholes and the right hand thumb covering the fingerhole nearest the bell. The bell can then be totally or partially covered with the right hand palm for the lowest notes, which sound like an ocarina. For better fingering in the upper register I use the left hand index, middle and ring fingers covering the upper three fingerholes nearest the bell. This still leaves most of the right palm available to partially cover the bell, which helps in overblowing some notes or in flattening the pitch as much as a full step, for pitch bends and tremendous vibratos.

The fingering arrangement in ascending succession of uncovering the fingerholes (with bell fully open) runs E, F, F#, G#, A#, B. Notes between B and the overblown E above can be obtained by overblowing with all fingerholes closed (which would give an E an octave above the low E) and then partially covering the bell to flatten the E down to the desired note. As you can see, some notes (particularly in the low registers) are hard to achieve and control. One of the problems with a short cow horn is that its taper is so large that achieving pitch control using only fingerholes limits the range of notes accessible without overblowing to about a fifth (E to B for example). By using the bell as a "palm hole," a larger range of notes can be obtained.

To construct the fipplehorn, the point of the horn is cut off to leave a flat circle about 1" in diameter. It is drilled and chiseled for a fipple block to create a windway. To make the tongue or edge, I cut a rectangular opening in line with the windway and inlay a piece of ebony for the tongue. The reason for not making the tongue out of the horn itself is that the horn has a grain to it just like wood; it absorbs and releases moisture just like wood, but it is more prone to cracking than wood. I seal all the end grain

(continued below right)

INSTRUMENTS

MAURICE RAVEL AND THE LUTHEAL

by Hugh Davies

Hugh Davies is one of the handful of British musicians who started to invent new instruments (mainly electro-acoustic) in the second half of the 1960s. He is a composer and performer whose works include not only pieces for his own instruments (often stereophonic or quadraphonic) but also, occasionally, live electronic music, tape works (mostly produced on a Fairlight II) and compositions for small groups of conventional instruments; several are music theatre compositions. He has also documented environmental sounds. Since 1964 he has published pioneering studies on electronic music and all types of instruments invented in our century, particularly as the main contributor (with 300 articles) in this area in the **New Grove Dictionary of Musical Instruments** (1984). We hope that he will be writing about some of his European colleagues in future issues of EMI.

The enormous growth in the invention of new acoustic instruments and sound sculptures in the second half of this century is, to a large extent, due to greater creative and artistic freedoms. It is no longer considered almost essential for a musician or artist to have undergone a traditional academic training. The barriers dividing composed music from freer interpretative forms such as jazz, folk and rock music have been partly eroded, as have those between the different art forms, so that it is no longer unusual for an artist from one medium to feature one or more others in mixed-media works without collaborating with specialists from those other media. Closer links between music and the visual arts since the 1950s can be seen in the assimilation in each of an element previously the domain of the other: in the case of music, the articulation of physical space (multiple loudspeakers, etc.), in the visual arts that of structuring events in time (as in kinetic art and experimental film and video).

All this has meant that in music since the 1950s there is no longer a problem for the instrument inventor about repertoire for each new instrument -- if the new instruments are not suitable for playing existing compositions ("Beethoven didn't compose for my instruments as they didn't exist then, so why should I try to play his music on them?"), they can be used in specially-composed pieces by the inventor and others, which can range from fully-notated to improvisational, in free solo or collective improvisations, and so on. Around the borders of this are other more popular forms of music which, because they use specially written compositions and arrangements, are not dependent on earlier notated compositions that must be performed exactly as the composer intended, and can more easily encompass newer instruments.

This helps to explain why there were very few instrument inventors in the first half of this century -- Luigi Russolo and isolated examples by other Italian and Russian Futurists, Harry Partch, I.A. MacKenzie and John Cage. Most of the small number of compositions for new instruments, apart from works by the above-named inventors, were for newly-invented electronic instruments like the theremin, ondes Martinot and Trautonium. The one composer who, within the limitations of the restrictions caused by the attitudes of the time, went furthest in the direction of assimilating new instruments was Maurice Ravel.

In his first opera, **L'heure espagnole** (The Spanish Hour; 1907) Ravel introduced one 'experimental' sound which, if played in a concert hall today, would be considered very avant-garde: in the introduction, which evokes the sounds of a clockmaker's shop with clocks ticking and chiming, the player of the sarrusophone (a brass instruments with a double reed) is instructed to remove the reed and blow trumpet-like through the instru-

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areas (the bell, the tongue, and the mouthpiece) to prevent cracking. I also lacquer the inside and outside for further moisture protection.

My first experiments in this direction were in wood since I have a lathe, but since my image of this instrument was to be something a shepherd might play sitting on a hillside and be heard some distance away, horn eventually became the material of choice. I've used cow horns because they work well and are readily available through Tandy Leather in 12" and 20" lengths, sanded thin (my preference) or unsanded.

ment. In 1933, near the end of his career, he authorized a performance of the first movement of his early string quartet by four of the newly-invented ondes Martinot.

It was his second opera, **L'enfant et les sortileges** (The Child and the Magic; 1920-24) that Ravel considered including three newly available instruments. The greatest loss to us today is the fact that he finally rejected one of them, one of Luigi Russolo's noise instruments, the Croaker, since that would have meant that one or more copies of the instruments would still exist in opera houses; as it is, no original Russolo instrument survives. Of the major composers who had heard these instruments at that time, including Stravinsky, Prokofiev, Varese and Honnegger, Ravel seems to have been the only one to have seriously considered using one in a composition, and indeed Russolo's Croaker would seem to have been ideally suited to this opera, with its animation of household objects and garden wildlife.

The second instrument was, in fact, not at all new. The Swannee whistle or slide flute has an ancient ancestry, but it was only introduced into Western light music early in the 20th century, and, once again, Ravel appears to have been the first serious composer to have used it.

It is the third instrument, a modified piano called the **lutheal**, that concerns us. I am very pleased that I finally have the opportunity to write about it, since it is one of only two articles that I would have liked to write for the **New Grove Dictionary of Musical Instruments** -- even if it meant replacing other short entries of mine -- but could not find sufficient information in the time available. Indeed my path to it now involved quite a bit of detective work, first in Dutch and then in French sources: the appendix of a self-published Dutch book on the history of the piano referred me to the disc recording listed in my bibliography; its sleeve/liner note mentions the Bordas dictionary, which in turn was based on Roger Cotte's lecture reported on in the **Revue de Musicologie**.

The variegated history of the piano has included various types of extended piano, with extra pedals, register stops, added 'bells and whistles' and so on. These were made especially in the years around 1800, when giraffe pianos featured up to eight pedals, which produced additional colors and effects, normally by affecting the vibration of the strings or by hitting them with unconventional objects: they included 'bassoon' (bass strings vibrating against parchment or tissue paper fixed to a bar or, presumably, in a movable frame), 'cymbals' (strips of brass striking the bass strings) and 'Janissary' or 'Turkish Music' with bells, triangles and drums (the latter obtained by a padded drumstick hitting the soundboard). In the early part of our own century there was a second wave of such instruments, in the (frequently player) pianos used in theatres and cinemas that incorporated pneumatically-operated percussion and sound effects.

The lutheal (derived from 'luth' = lute) is a piano with additional registrations (harpsichord, harp-lute and cimbalom) which was developed by Georges Cloetens in Brussels around 1918. Little is known about the inventor apart from what can be gathered from sifting through 65 years of Belgian paten abstracts and a few years of French ones. Between 1904 and 1949 he was granted 21 patents. The only two that were not concerned with musical instruments were for an improved hypodermic syringe (1949) and for printing advertising on toilet paper (1921)! His first six patents were for a simplified organ action (1904) and (1908-13) for a multi-timbral organ pipe which contained several different reeds (also to be used for car horns and alarms). The last of these and all his subsequent musical patents (up to 1947) were licensed to G. Van der Haeghen in Brussels, presumably a manufacturer of keyboard instruments (a visit to Brussels would be necessary to research this further, to see a restored lutheal and to investigate if there are any surviving family members who might have more information on Cloetens' life and work). These patents were all for improved, simplified or new mechanisms in pianos, pipe organs and reed organs, with the exception of one in 1927 for a monochord stopped by means of "tangents," like the melody string on a hurdy-gurdy, the amplified Radiotone from around 1930 and the instruments developed in the last few years by Bob Bates.

Cloetens' relevant Belgian patents concern mechanisms that could be added to an existing piano, rather than a complete extended piano, and show his explorations that led to the lutheal: Nos. 278726 and 280282 (1919), 292081 (1920) and, most important, 306002 (1922). The illustration is from the last of these. Due to the fact that only summaries of Belgian patents are available on the shelves of the London patent office library, while the patents themselves need to be ordered in advance, with only limited time I instead checked to see whether Cloetens had taken out any French patents. This turned out to be the case, though, for some reason, they are all jointly credited with two Belgian colleagues who had, in the Belgian patent lists, only co-authored three of Cloetens' patents for organ mechanisms. The relevant French numbers are 508170 (1920), addition 24129 (1921) and addition 26149 (1923). Paradoxically the first patent could also not be consulted on the spot, but the two additions were available.

The second Belgian patent and part of the first French one describe a small metal plate that can be placed over the striking surface of the piano hammer. Each of these would have had to be removed when the piano was required for normal use. In the third Belgian patent and first additional French one the removal of the plate is avoided by fixing it to the side of the hammer in such a way that it only comes into contact with the string when the left pedal is depressed and the hammers are moved laterally; since the plate protrudes slightly, where the strings are grouped in sets of two or three only one of them is struck, and the others resonate sympathetically.

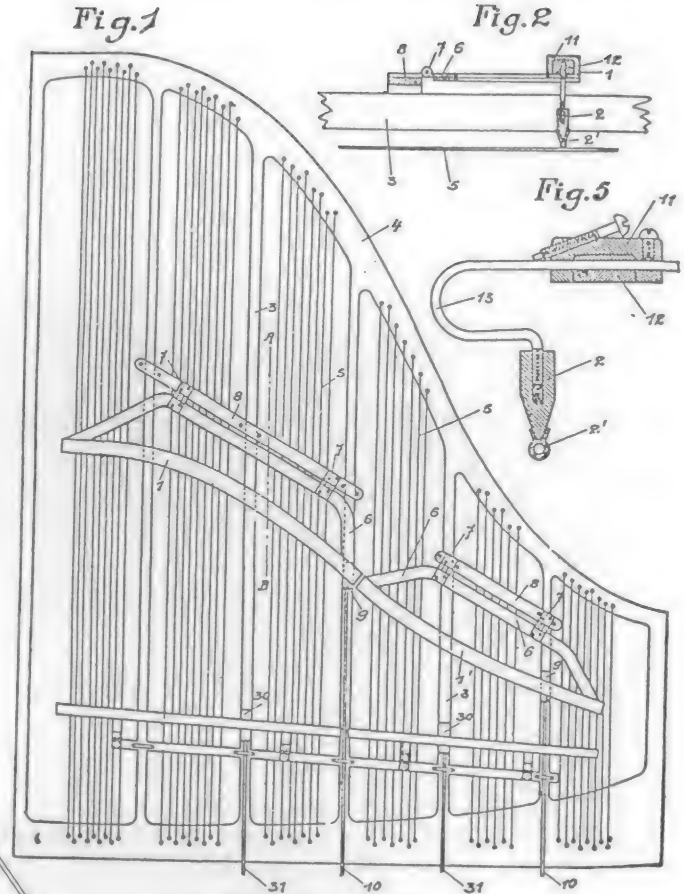
Cloetens does not appear to have pursued this form of tack piano, and the lutheal's mechanisms were developed from other ideas. The first Bel-

SOME OF THE DIAGRAMS FOR CLOETENS' BELGIAN PATENT 306002 (1922) AND FRENCH PATENT 2ND ADDITION 26149 (1923).

Fig.1. Nearest to the keyboard are the two sections of bar 30 that hold the "jacks" for the harpsichord timbre (positioned at about 1/3 of the way along the length of the strings), which are operated by the two register stops 31. The two sections 1 and 1' forming the shallow inverted S-curve contain the set of harp-lute dampers, operated by the two register stops 10; they are hinged at 6/7/8 and place the dampers halfway along the length of each string.

The photographs of the Brussels lutheal show a metal piano frame that contains only three rather than five internal lengthwise struts, with the two register mechanisms for the jacks fitted on top of the outer two of the three struts and those for the dampers mounted outside them on the two edges of the frame; inverted U-shaped brackets are used to link the parts of each treble and each bass mechanism that are separated by the struts. The two large hinged D-brackets on which the harp-lute dampers are mounted are matched by two simpler, smaller ones for the harpsichord jacks, which are hinged on the opposite side, so that when neither stop is in use the appearance slightly resembles a set of open jaws. The treble-bass split point is approximately g'/g#'.

Another ten figures show details of the mechanisms. Figs. 2-6 propose methods for mounting the lute-harp dampers. In Fig.2 the hinge 6/7/8 is mounted on the piano frame 3, with the damper 2/2' resting on the string 5. Fig.5 shows a damper from one side, with its adjustable weighted mounting block. In both of these the solid damper 2, at the end of the curved arm, has a felt-covered striking surface 2'. Three other figures show methods of mounting the harpsichord jacks.



Dessin joint au brevet définitif de CLOETENS

gian patent and part of the first French one propose methods of obtaining a plucked string quality by bringing a solid "damper" into contact with each of the strings, which in later patents could also take the form of a metal rod. The final patents (1922/1923) show two different mechanisms in the form in which they are used in the lutheal, as can be seen in the illustration from them. Two treble and two bass stops are added to a normal grand piano, producing harpsichord and harp-lute timbres; when both are activated simultaneously the timbre resembles that of the Hungarian cimbalom.

The harpsichord timbre is achieved by lowering a rectangular bar into position by means of the lever behind the stop knob. On the underside of the bar is attached a row of rigid metal rods or "jacks" that resemble long thin bolts with domed heads at their lower end. They protrude about two inches below the bar with their heads resting on the strings, just beyond the normal dampers, and the height of each one can be adjusted by means of a thread on its upper half where it passes through the bar. The jacks create a compressed, slightly metallic quality that resembles that of a harpsichord or, at times, even more that of a fortepiano. The cimbalom timbre, produced by both stops together, is perhaps the most convincing.

The plucked harp-lute quality is created by a set of substantial felt "dampers" that can be lowered into position; these dampers are placed at the center of each string's length, between the vertical jacks and the hitch pins at the far end of the piano strings. In his patents Cloetens had proposed using more than one set of jacks for different notes on the strings; in practice on the lutheal this was limited to the central node for the first overtone, producing a sound one octave higher. Indeed the combination of the mechanisms for the two pairs of stops substantially fills the space above the strings. Even though the piano strings are under great tension, are thicker and are heavier than those of other string instruments, the damper mechanism must still exert a substantial downwards pressure, far more than with the normal dampers that rest lightly on the strings (try plucking a string on a grand piano and progressively pressing its damper down onto it), which must at least be an equivalent pressure to that for producing harmonics on a bowed string instrument by pressing lightly on a node.

The only composer known to have written especially for the lutheal is Ravel, who not only included it, primarily for it harpsichord timbre, in his second opera (with an alternative suggestion of placing sheets of paper between the strings of an upright piano, a technique previously used in Erik Satie's La piege de Meduse of 1914) but also, and more importantly, specified it as the accompanying instrument to the violin in his Tzigane (1924). It was used in the premiere of the latter work in Paris on 15th October 1924, although subsequently, for practical reasons, the piano replaced it. The published score gives (parenthetically) the lutheal as an alternative to the piano. The cimbalom stop combination is, of course, ideal for the Eastern European gypsy (in French "tzigane") flavor of the piece (dedicated to a Hungarian violinist), which Ravel also brought out in his orchestration of the work.

The original Gaveau lutheal used in early performances of these two works by Ravel seems to have disappeared, probably destroyed in a fire

during the Second World War. Theo Olof, a well-known Dutch violinist, discovered that the Musical Instrument Museum of the Music Conservatory in Brussels possessed the remains of another lutheal. It turned out to be possible to restore this modified 1911 Pleyel grand piano, a labor of some 600 hours which was completed in 1979 by the piano renovator Evert Snel; a television documentary of the whole process, up to the first concert performance, was made by NCRV in Holland. The disc recording performed on the restored instrument is quite a revelation of the composers's original intention. Instrument makers would no doubt prefer that Ravel had explored its other timbres more thoroughly, as is demonstrated on the same record by the set of demonstration variations in different styles by Daniel Wayenberg. Olof and Wayenberg also plan to create further repertoire for violin and lutheal.

One question remains, however. One of the record album photos shows the manufacturer's label inside the keyboard lid, on which can be read: Cavaille-Coll / Paris / l'Orpheal / Brevets (= patents) Cloetens. Orpheal and not lutheal! What was the difference, if any? Only Curt Sachs (**Real-Lexikon der Musikinstrumente**, 1913) based on a 1911 report, and his follower Sibyl Marcuse (1964) briefly mention l'Orpheal, as "a combination of grand piano, organ and harmonium" invented by Cloetens in 1910, which does not seem to correspond to any of his patents of the period. Did he retain the name for his later extended piano, in addition to "lutheal", or was it taken over by Cavaille-Coll to distinguish their instrument from Gaveau's lutheal? Although the Pleyel piano is dated 1911, the lutheal mechanisms were probably not installed until about 1923. To add to the confusion, Gratia's survey of new instruments (1928), published in France, describes another extended modified Pleyel piano from 1926 (but, surprisingly, not the lutheal or orpheal), in which brass tongues folded around thin strips of felt were placed between the hammers and the strings to imitate the sound of a harpsichord, similar to the system proposed in Cloetens' earlier patents, and possibly based on them. It was used in dramatic works by the French composers Gabriel Pierne and Reynaldo Hahn in 1926-27 and in 1928 by the conductor Bruno Walter for Mozart performances. More research is clearly needed, both in Brussels and Paris.

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ORGANIZATIONS & PERIODICALS

THE VESTAL PRESS
320 N. Jenson Rd., PO Box 97,
Vestal, NY 13581-0097

Reviewed by Bart Hopkin

Experimental Musical Instruments regularly reports on orgainizations and periodicals of potential interest to its readers. In this issue we look at a publishing house that distributes an array of unusual and hard-to-find musical materials.

It is often remarked that prior to the days of electronic home entertainment a much larger part of the population than now engaged actively in music making. What did they do before radio and TV? They **sang**. But it should be remembered too that those were also the glory days of mechanically reproduced music. In the decades around the turn of the century, an extraordinary amount of human ingenuity went into the creation of diverse music machines. From that optimistic, Newtonian age came ever-more sophisticated reproducing pianos, elaborate theater organs with all their famous bells and whistles, and any number of other outlandish hybrid devices.

The best collection of materials documenting that era will be found in the catalog of the Vestal Press, a mail order book publishing and distributing company. The Vestal Press was founded by Harvey Roehl, originally as an extension of his research into player pianos. "I had always wanted to see something in print on the subject," he says, "and back in the fifties soon learned that there was nothing." By 1961 he had assembled a book, still in print, called **Player Piano Treasury**, and with its publication and distribution the company was born.

The catalog soon came to include materials on reed organs, calliopes, and eventually the full range of mechanical instruments, theater organs and such. More recently the scope has broadened to include other, non-musical early mechanical and electrical devices, early Americana, popular culture artifacts and the like.

Some of these publications are produced in-house, including reprints of rare older materials such as service manuals for all types of mechanical instruments. Others are produced elsewhere and distributed by Vestal. Vestal also produces and distributes recordings of a wide variety of instruments, some from outside sources and some from the Roehl's own collection. I myself purchased something called **Encyclopedia of Automatic Musical Instruments** by Q. David Bowers (1000 pages, profusely illustrated), a reprinted manual for the automatic violin-playing device called Violano Virtuoso, and recordings of sundry instruments (you should hear the Oceanic March played on Encore Banjo, without benefit of human hands).

The best way to connect with the Vestal Press and its offerings is to write for a catalog, at the address given above. They also put out a newsletter, the **Vestal Press House Organ**, which reports on in-house events, current projects and the like.

BENTWOOD CHALUMEAU -- A GLISSANDO CLARINET
by Bart Hopkin

According to the standard general definition, a clarinet is a cylindrical bore wind instrument employing a single beating reed. In this connection we tend to think first of the western orchestral clarinet in Bb or A; but there are, of course, related instruments throughout the world which meet the broad description. While these instruments differ in various ways, the physical facts of the reed and the bore work to ensure that they have a characteristic clarinetty tone quality, especially in the fundamental register.

To me that sound is one of the most beautiful of instrumental timbres. I am particularly partial to the chalumeau register; that is, the lower, fundamental register mentioned above, with its open quality of widely spaced overtones. Sadly, in recent decades the clarinet has waned a bit in popularity, especially in popular music and jazz.

I have tried to bring a little more clarinet music into the world by designing a continuous-pitch clarinet, which I have been calling bentwood chalumeau (named after an 18th century ancestor to the modern instrument). In place of tone holes and keywork producing a scale of discreet pitches, my instrument employs a system which allows for a continuous glide over the entire range. The arrangement is simple enough that, after working out the design on paper a little over a year ago, I was able to build a successful prototype in a few hours using materials on hand around my work area. I've since built two somewhat more refined versions, given one to Jim Russell, a performing clarinetist who has recently been using it in concert, and with the other done a lot of fooling around and some informal recording on my own.

The idea of making a continuous pitch clarinet has cropped up in various times and places. Peter Schickele, aka PDQ Bach, used one made from the telescoping base of a Manhasset music stand on one of his recordings -- unless my memory is faulty and his was a slide oboe. Robin Goodfellow makes a tiny slide clarinet out of telescoping pairs of soda straws with an idioglottal reed cut in one end (see EMI Vol. II #1). I have heard mention of other slide clarinets, but my information is shaky and I have no word as to how they operate or how effective they have been.

There are certain difficulties inherent in the creation of a continuous pitch clarinet. The natural inclination in designing such an instrument is to proceed by analogy to other successful continuous pitch wind instruments. But the two seemingly promising models we have -- slide whistles and slide trombones -- both operate in ways that aren't suited to clarinets.

It only takes a moment's thought to see the problem with the slide whistle model. Slide whistles work on the basis of a sliding stopper which varies the length of a sounding tube by closing the end at a movable point. This works because it is possible to have a closed-tube flute. But with reed instruments, the player must blow through the tube. You can't blow through a stopped tube.

You can blow through a trombone-style sliding open tube, but here another sort of problem arises. With most brass instruments, the first overtone produced above the nominal fundamental is a fifth, followed by a continuing harmonic series of progressively smaller intervals. A fifth, thus, is the largest interval between one pitch and the next for a given tube length. It is the job of the slide (or, for other brass, the valves) to make available the pitches in between by altering tube length. For instance, the trombone's seven regular slide positions fill in the seven semitones between E and Bb, and with B natural we return to the original slide position and blow the next overtone. To achieve that required pitch change of a tritone, the sounding length of the tube must be able to expand to a just under one and a half times its shortest length, creating a length ratio between longest and shortest of a little less than 3/2. A two-piece telescoping slide ideally can double its length; with the bell and mouthpiece added into the equation the trombone can still manage that 3/2 ratio.

Clarinets, on the other hand, don't overblow a fifth, but a twelfth. To fill in the space between the fundamental and that first available overtone, the ratio between the longest and shortest tube length would have to be just short of 3/1. A 3/1 expansion is not possible with a two piece slide. It could be done ideally with three pieces telescoping inside one another; practically speaking it takes four. Four telescoping slide pieces means lots of opportunities for leaks, awkward questions concerning the order in which the segments expand out from one another, and an irregularly-shaped bore, no longer cylindrical, with several abrupt changes in diameter. With very thin tubing and very fine tolerances it might be possible, in the best of circumstances, to manufacture an effective compromise instrument along those lines. But it makes sense first to search first for a better way.

Habitual modes of thought can prevent us from seeing things which seem in retrospect to have been simple and obvious. Tunnel vision may allow us to examine in painstaking detail an artificially small set of options, and fail to see the ready solution just off to one side. As I set about trying to design a workable glissando clarinet, my thinking remained constrained by the images of trombones and slide whistles; with those models in mind I kept wanting to slide somehow, and I was hitting dead ends.

What finally broke the cycle for me was reading about musical instruments designed but never built by Leonardo da Vinci (you know, great minds...). The book was **Leonardo da Vinci** as a Musician by Emanuel Winternitze, and I was reviewing it for

EMI Vol. III #1. Among the sketches in Leonardo's notebooks are some drawings of flutes with much elongated toneholes, accompanied by notes to the effect that these were meant to be sliding pitch instruments. How Leonardo imagined that the long holes were to be slidingly covered and uncovered is not clear -- one imagines a rubbery sort of finger movement that would in practice be impossible for anyone except perhaps a more fully realized Gumby toy.

This was enough to start me thinking in terms of neither stoppers nor expanding tubes, but rather a tube with a single open slit running its length, like one continuous tone hole. A method for progressively opening the slit came to me when, in a lucid moment, I stopped sliding and started flexing. The idea is simply this: The body of the clarinet is a cylindrical tube with an open slit running along the top from a point near the mouthpiece all the way to the far end. At the mouthpiece end where the slit begins, a long flexible tongue is attached over the slit. The tongue has a uniform upward curve, so that from the point of contact with the tube it curves up and away tangentially. It is positioned so that when the player takes advantage of its flexibility to press it downward, it comes down over the slit, covering more and more of it as it is pressed further down. As more of the slit is covered (assuming a good seal is made all along the contact surfaces) the effective vibrating length of the tube increases, allowing for a continuous range of pitches.

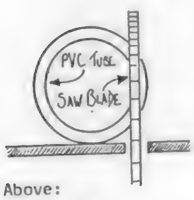
Here is a complete description of the finished instrument, the bentwood chalumeau, that resulted:

A standard clarinet mouthpiece and reed are attached to a two foot length of 3/4" PVC conduit. The connection between the two is made by a standard PVC coupling, analogous to the barrel joint on an orchestral clarinet. (The mouthpiece side of the coupling must be slightly enlarged to accommodate the inserted part of the clarinet mouthpiece, but the fit is reasonably close.) With the mouthpiece and tube shoved in close together inside the coupling, a minimum of acoustic disruption occurs at the joint -- presumably no worse than a clarinet expanded at the barrel joint for lower tuning. (For the bentwood chalumeau, the tuning function of the clarinet barrel joint can be disregarded, since with complete flexibility of pitch one need never retune.)

The PVC tube has a slit about 3/8" wide running from the far end to a point about an inch short of the coupling. The slit is made not by making two cuts directly into the tube, but by making one slice from the side, as shown. This creates a wide, level surface on both sides of the slit, which can then accommodate a strip of padding for an effective seal. This convenient seating for the pad is the reason for using PVC tubing, which is relatively thick, rather than something more elegant like brass or aluminum tubing. PVC is also cheaper and very easy to work.

The sealing strips along either side of the slit are cut from dense foam rubber weather stripping. It has an adhesive backing which attaches nicely to the flat surfaces described above.

The flexible tongue is a thin strip of springy hardwood. To give it the required curvature it is



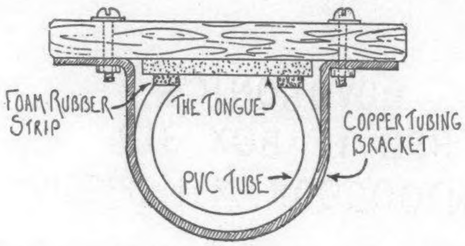
Above:
Making the slit with one cut.

At right:

BENTWOOD CHALUMEAU. The curved metal piece rising from the end of the tube is meant to serve as visual guide for the player, with approximate pitch locations marked off on it.

first boiled to soften it, then allowed to dry in a curved shape, which can be achieved by clamping it around a something like bucket. Getting uniformity of curvature and the right degree of springiness in the tongue is the only tricky part of the whole operation. If the tongue is too stiff it can be difficult to operate; if too flexible it tends not to make a tight seal with the weather stripping when pressed down. If the curvature or rigidity is irregular, areas here and there along its length will tend to rise when lower points are pressed down, once again breaking the seal. Any leak in that seal has the same effect as leaky pads on a standard clarinet, causing the instrument to squeal and fail to speak at the intended pitch. It seems to help a bit to make the tongue very slightly thinner toward the far end. I found it useful to make several tongues of slightly differing thicknesses and curvatures, and then to select the best when they had dried.

The tongue is attached by means of a copper and wood collar.



The instrument has no bell. The bell on a standard clarinet theoretically affects only the lowest tone, and this seems to be born out in practice. A copper ring circles the far end of the tube, for decoration as well as reinforcement.

Embouchure for the bentwood chalumeau is that of the clarinet, and anyone with clarinet experience can play the new instrument immediately. The fingering technique, of course, is unorthodox and benefits from a little practice. The idea of raising and lowering the tongue to produce a continuous range of pitches is easily grasped, and the higher pitches, requiring a shorter part of the tongue pressed down, work effortlessly. It takes more practice to ensure a tight seal in the lower notes. The higher parts of the tongue need to be reinforced -- that is, held down -- by the fingers of the left hand, while those of the right hold down the far end at the point that determines resulting pitch.

The tone quality of the instrument is characteristically, unmistakably clarinet. On the instruments I have built it is not as full and fine as on a good classical instrument; whether a finely-crafted wooden bentwood chalumeau could sound as well is a matter of speculation. Traditional clarinets are full of acoustic irregularities in the bore, caused by the presence of the toneholes in various sizes and spacings and the soft pads that cover them. The bentwood chalumeau could be considered more uniform, with no change in bore shape over its length. It has a different sort of irregularity though, in the odd cross section shape caused by the slit and tongue arrangement. Whether uniformity in the bore is

Bentwood chalumeau in playing position, demonstrated by the author.

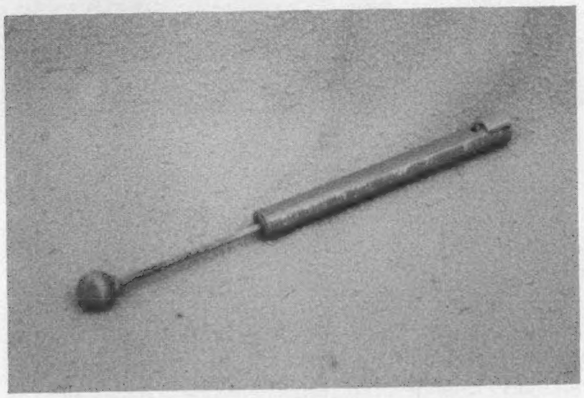
desirable is also a matter of speculation; it has been argued that the irregularities of the tone-holes mitigate the tone of a clarinet in a desirable way. Who knows?

A range of two full octaves is possible on the bentwood chalumeaus constructed so far. There are no register changes in this entire range. It is all in the fundamental register, and possesses that characteristic chalumeau tone quality throughout, which other clarinets lose in the upper registers. (Experienced clarinet players can bring out the upper registers on the new instrument as well, but since there are no register keys it is more difficult than on a classical clarinet.) Quickly and accurately finding specific pitches, given the unorthodox action, is a challenge. The peculiar wobbly quality is truly unusual, and, I find, both evocative and satisfying -- although, as with all sliding pitch instruments, it can easily be overdone.

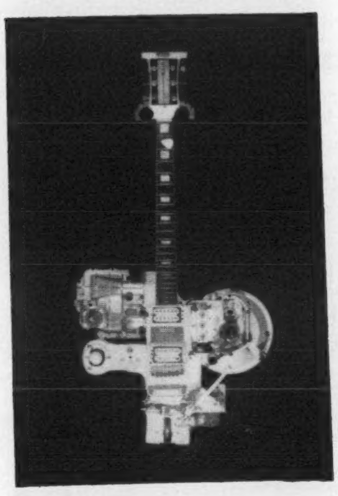
For more information on the bentwood chalumeau interested people can contact the author at EMI's regular address: PO Box 784, Nicasio, CA, 94946.

NOTES FROM RECENT CORRESPONDENCE

HERE IS ANOTHER easily-made slide whistle, recently sent to EMI by Bob Phillips. (Readers may recall that he previously sent a slide whistle in the form of a syringe designed for hospital use. Following that, we presented one given us by Jacques Dudon, made, with a minimum of modification, from a bicycle pump). The fipple on this one, clever and simple, is made by gluing on a short segment of a partial radius of the same PVC pipe from which the body of the flute was made. Bob credits the idea for this arrangement to Katherine Moore.



ON OUR RECENTLY RELEASED cassette tape, From the Pages of Experimental Musical Instruments Volume III, is a piece excerpted from Hybrid Antics, featuring Hybrid Instruments built by Ken Butler. The liner notes for that piece were partially incomplete because we were unable to obtain full information on two of the instruments in time for the release. The photo here shows one of them --the manifold guitar, on which John Butler plays his soaring solo. It is made much like a standard electric guitar. The body, however, is an engine manifold, and a few items like a swizzle stick auto-strum have been added.



KEN BUTLER'S
MANIFOLD
GUITAR

NOTICES/EVENTS

THE MUSIC MAKERS, an exhibition of musical instruments by contemporary makers from around the world, will take place at the Dairy Barn Southeastern Ohio Cultural Arts Center in Athens Ohio, Sept. 17- October 16 1988. Traditional reproductions to experimental avant-garde; performances, lectures & workshops. (614) 592-4981 for more information.

FORTH AND BACK
By Denny Genovese

This cassette is all electronic and uses the Harmonic Series scale (Harmonics #1 through #32). It is conceived for use in two different ways: When played very quietly it functions as a harmonious sonic environemnt for contemplation, massage, conversation, etc. When played louder, it provides sublime listening pleasure and is a rare example of how this scale can work musically. For superior sound quality and mechanical reliability, Maxell tape is used for all copies.

Also available -- the OEM Cassette: a new cassette featuring Bass Marimba, Hammerstrings, Tubular Bells, Fipple Pipes and other instruments played by members of Sarasota's Organization for Experimental Music.

Each cassette costs $7.99 from Dennys Sound and Light, PO Box 993, Nokomis, FL 34274.

WATERPHONES -- Two new models are now available. "Small" for $185 and the "Whaler" -- $295. These stainless steel and bronze instruments are easy to play by bow, mallets & by hand. Write Richard Waters, 1462 Darby Rd., Sebastopol, CA 95472. A demo cassette is available for $8.00.

CASSETTE TAPES FROM EMI: From the Pages of Experimental Musical Instruments, Volumes I, II and III are available from EMI at $6 apiece for subscribers; $8.50 for non-subscribers. Each tape contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, beautiful, funny and lively music. Order from EMI, PO Box 784, Nicasio, CA 94946.

The British Shakuhachi Society has grown into THE INTERNATIONAL SHAKUHACHI SOCIETY, with officers in Japan, Britain, the US, and other countries. The address is Wadhurst, Sussex, TN5 6PN, England.

"HOW TO PRODUCE AND PROMOTE SMALL CONCERTS." It's not the last word, but a few good ones for those with ANY doubts. $5.00, Jeff Brown, 135 West 2nd St., Juneau AK 99801.

CLOCKWORKS
SOUND
ARCADE
An Installation by
Bill and Mary Buchen

It ticks, tocks, rings & rocks! Clockworks Sound Arcade will be at Staten Island Children's Museum at Snug Harbor for the next several months. For information call (718) 273-2060.

BART HOPKIN IN CONCERT, in the New Instruments/New Music Series, Sunday, September 4 at 2:00 pm at 3016 25th St., San Francisco, CA, 94110. The editor of EMI will stop editing long enough to pile as many of his musical devices as can fit in the back of his truck, drive to the city, and play some music. Coinciding with the concert will be an exhibit of Robin Goodfellow's exquisite drawings of instruments from her extensive and exotic collection. For further information, call Bart at (415) 662-2182 or series director Tom Nunn at (415) 282-1562.

PASIC 88, this year's meeting of the Percussive Arts Society, will take place in San Antonio, TX, November 16-19, 1988. For information contact PAS, 214 W. Main St., Urbana, IL 61801.

THE GLASS MUSIC FESTIVAL will take place at the Corning Museum of Glass, Oct. 12 - 16, 1988. For more information contact Glass Music International, 2503 Logan Dr., Loveland, CO 80538; phone (303) 669-5791.

The Ohio Gourd Show will take place at the fairgrounds in Mt. Gilead, Ohio, on Oct. 1-2, 1988. For more information contact Mr. O.C. Stevens, PO Box 274, Mt. Gilead, OH 43338; phone (419) 946-3302.

SOUND GARDEN 2, an exhibit of new sound sculpture, will take place at Striped House museum of art, Roppongi, Tokyo, September 1 - 13. On Saturdays and Sundays, the artists will perform on their own works.

The Musical Saw Festival will take place at the World Forestry Center in Portland, Oregon, September 24 -25, 1988. For information contact Mike Barnes, World Forestry Center, 4033 SW Canyon Rd., Portland, OR 97211 (503) 228-1367.

PRIZE FOR A NOBLE PEACH

Dr. Elmer Kirchoff, Assistant Regional Superintendent of Schools in St. Clair County, Illinois, received the No-Bell Prize this spring. Dr. Kirchoff was selected for the award because of his commitment and dedication to music education.

The award was constructed at St. Clair Music Shoppe, where co-owners Bob Wilson and Tom Tapscott made the final selection from among the candidates. It was made from a Conn Director cornet, a Conn Director trumpet mouthpipe, and some additional generic parts. Needless to say, Dr. Kirchoff was overwhelmed at the presentation ceremony.

Reprinted courtesy of the editors of Techni-Com, newsletter of the National Association of Band Instrument Repair Technicians ((Box 51, Normal, IL 61761). Photo by Tom Tapscott.

RECENT ARTICLES IN OTHER PERIODICALS

Listed below are selected articles relating to unusual musical instruments which have appeared recently in other publications.

ANNEA LOCKWOOD by Tony Coulter, in **Ear** Vol. 13 #4 (325 Spring St., New York, NY 10013).

The author interviews Annea Lockwood, a composer whose work frequently emphasizes either timbral or conceptual qualities of specific sound sources, as with her geographic sound studies of rivers, experiments in piano destruction, and explorations of glass sounds.

OCARINAS by Robin Goodfellow, in **Music for the Love of It** Vol. I #3 (67 Parkside Dr., Berkeley, CA 94705).

Robin Goodfellow provides an overview of ocarinas old and new, accompanied by her beautiful ink drawings of several instruments.

THE WORLD OF EXPERIMENTAL MUSICAL INSTRUMENTS by Bart Hopkin, in the same issue of **Music for the Love of It**.

EMI editor Bart Hopkin takes a brief look at some trends in new instrument building.

A PINBALL GAME? BY BEETHOVEN? by Art Weber, in **Music for the Love of It** Vol. I #2 (address above).

The word "Bagatelle," it turns out, referred centuries ago to a popular pinball game complete with musical sound effects. This article suggests that Beethoven's Bagatelles were composed with the spirit of those early games in mind, and in some passages literally imitated the sounds.

HOW GEMEINHARDT MAKES FLUTES (author not credited) in **The Music Trades** (80 West St., PO Box 432, Englewood, NJ 07631).

This article appears to have been written for PR purposes by someone at Gemeinhardt. That said, it does provide an informative, if brief and non-technical, view of a contemporary large scale instrument manufacturing operation, and includes several fine, explicit photographs.

GOD'S BIG NOISE, Maryanne Amacher interviewed by Jeff Bartone, in Musicworks 41, Summer 1988 (1087 Queen St. West, Toronto, Canada, M6J 1H3).

A sound artist who works with relationships of sound and place, relocating sound by means of mics and speakers from one environment to another, talks about her work.

CROSSINGS -- an introduction by Pauline Oliveros, followed by an interview with Alvin Lucier conducted by James Tenney, in **Musicworks** 41 (address above).

Alvin Lucier discusses several pieces from his truly fascinating body of work. The pieces, very divergent in realization, each are ventures into acoustic or psycho-acoustic possibilities, all being as much phenomenological exploration as music. Included in the article is the score for Lucier's 1984 composition, **Crossings.** On the cassette tape accompanying the issue is **Clocker**, a piece for a ticking electric clock, biologically voltage-controlled.

As always, several interesting articles appear in the current issue of **American Lutherie** (#14, Summer 1988; 8222 South Park Ave, Tacoma, WA, 98408):

WHY ARE OLD VIOLINS SUPERIOR?, by Graham Caldersmith, seeks out and presents well-considered, knowledgeable opinions by numerous people in a position to deliver them, suggesting that the fabled superiority of certain very old violins is more a matter of tradition than empirical fact. Ha! I suspected it all along.

GENE RHINEHART'S RESOPHONIC GUITAR CONES is an interview with a maker and designer of dobro-type guitar resonator cones. Mr. Rhinehart explains design considerations, procedures for fabricating the cones, & more. Several good photos included.

HISTORICAL LUTE CONSTRUCTION: THE ERLANGEN LECTURES, DAY THREE, by Robert Lundberg, continues AL's series of transcribed talks by the master luthier accompanied by sets of plans.

OUR GREAT SPHERICAL FRIEND, PART V: AN EXPERIMENTAL BASS, by Frederick C. Lyman, Jr., describes the construction of a prototype alternative string bass design. Without diagrams the description is hard to follow, but it involves creating an air resonating chamber which is relatively independent of the soundboard that gets the air going. The author promises more complete information as the experiment proceeds.

Journal of the Catgut Acoustical Society, Vol. I #1 (Series II), May 1988 (112 Essex Ave, Montclair NJ 07042), contains several noteworthy articles:

MICROSCOPY OF WOOD FINISHES by C.Y. Barlow and J. Wodehouse presents scanning electron microscope photographs of spruce and maple surfaces. A fascinating look at the minute cellular structure of instrument building woods.

FEATURE ANALYSIS AND MUSICAL TIMBRE, by Howard Pollard, attempts to lay groundwork for quantifiable analysis of timbre by comparing subjective impressions of sound quality to results obtained by precise electronic sound measuring implements.

RECONSTRUCTING KING DAVID'S HARP, by John Wheeler, describes the author's attempt to create something funtionally similar to the harp (actually a lyre, the author concludes) of the biblical King David.

EMI's readers should be aware of **Logos-blad**, newsletter of the Logos Foundation in Belgium. Much innovative sound exploration takes place at the Logos Foundation, with an active core group plus visiting artists from around the world. The newsletter is published, in Dutch only, by the Logos Foundation, Kongostraat 35, 9000 Gent, Belgium.